DOCUMENTS EXPEDITING PROJECT

85th Congress
2d Session

JOINT COMMITTEE PRINT

REPORT OF THE UNDERSEAS WARFARE ADVISORY PANEL TO THE SUBCOMMITTEE ON MILITARY APPLICATIONS OF THE JOINT COMMITTEE ON ATOMIC ENERGY

JOINT COMMITTEE ON ATOMIC ENERGY

CONGRESS OF THE UNITED STATES

AUGUST 1958

Printed for the use of the Joint Committee on Atomic Energy

UNITED STATES
GOVERNMENT PRINTING OFFICE
29792 WASHINGTON : 1958

JOINT COMMITTEE ON ATOMIC ENERGY

CARL T. DURHAM, North Carolina, *Chairman*

CLINTON P. ANDERSON, New Mexico, *Vice Chairman*

CHET HOLIFIELD, California	RICHARD B. RUSSELL, Georgia
MELVIN PRICE, Illinois	JOHN O. PASTORE, Rhode Island
PAUL J. KILDAY, Texas	ALBERT GORE, Tennessee
WAYNE N. ASPINALL, Colorado	HENRY M. JACKSON, Washington
JAMES E. VAN ZANDT, Pennsylvania	BOURKE B. HICKENLOOPER, Iowa
JAMES T. PATTERSON, Connecticut	WILLIAM F. KNOWLAND, California
THOMAS A. JENKINS, Ohio	JOHN W. BRICKER, Ohio
CRAIG HOSMER, California	HENRY DWORSHAK, Idaho

JAMES T. RAMEY, *Executive Director*
JOHN T. CONWAY, *Assistant Director*

SUBCOMMITTEE ON MILITARY APPLICATIONS

HENRY M. JACKSON, Washington, *Chairman*

CLINTON P. ANDERSON, New Mexico	CHET HOLIFIELD, California
JOHN O. PASTORE, Rhode Island	JAMES E. VAN ZANDT, Pennsylvania
JOHN W. BRICKER, Ohio	JAMES T. PATTERSON, Connecticut

LETTER OF TRANSMITTAL

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON MILITARY APPLICATIONS,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C., August 19, 1958.

Hon. CARL T. DURHAM,
Chairman, Joint Committee on Atomic Energy,
Washington, D. C.

DEAR MR. DURHAM: I wish to thank you for publishing the report of the Underseas Warfare Advisory Panel to the Subcommittee on Military Applications of the Joint Committee on Atomic Energy. I know that you agree with me that the findings and recommendations and the detailed analysis as contained in the panel's report deserves the attention of all persons who are concerned with the adequate national defense of the United States.

As you know, the Underseas Warfare Advisory Panel was formed on March 7, 1958, with the express purpose of assisting the Subcommittee on Military Applications in a study of the adequacy of our country's underseas warfare systems. In selecting members for the panel, I was extremely fortunate to secure the services of six capable men whose past experiences in the area of inquiry made them especially competent to study and report on the specific problems with which we were concerned.

On June 25, 1958, the advisory panel submitted to me its detailed report which because of the sensitive information contained therein was classified "secret." Copies of the classified report were sent by me to the Secretary of Defense and to the Secretary of the Navy. In addition, on behalf of the subcommittee, I submitted the report to you for the information of all members of the Joint Committee on Atomic Energy.

In view of the importance of this report, it was my feeling that, consistent with national defense, the details of the report should be made public. I, therefore, requested the assistance of the Department of the Navy and the Atomic Energy Commission to review the report for classified information. Accordingly, information—the public dissemination of which would adversely affect the defense of the United States—was deleted prior to the public printing.

The United States and the free world today face a formidable threat from a large number of Soviet submarines, many of which are capable of launching missiles with nuclear warheads. Defense against this threat in great part will be dependent upon an adequate number of United States nuclear-powered attack submarines, coupled with the deterrent effect of adequate numbers of Polaris missile carrying nuclear submarines which, in turn, will necessitate an adequate knowledge of oceanography.

The United States is fortunate that through the efforts of the Naval Reactors Branch of the Atomic Energy Commission and the Bureau of Ships, United States Navy, this country leads the world today in the development and operation of nuclear submarines. It is imperative that such leadership must not falter nor be permitted to lag through ill-advised and dangerous budget limitations.

On behalf of the Subcommittee on Military Applications, I wish to express our thanks to the members of the Underseas Warfare Advisory Panel for the time and effort they put into this work. I strongly believe that their report will be of assistance to the Department of Defense and to the Department of the Navy in determining future defense policies and that, if the recommendations of the panel are followed, they will do much to guarantee continued United States naval supremacy in the years to come.

Sincerely yours,

HENRY M. JACKSON,
United States Senator, Chairman, Subcommittee on Military Applications.

CONTENTS

	Page
Letter of transmittal	III
Introduction	1
I. Summary of Main Findings and Recommendations	3
II. The Problem	5
III. The Peril—Today and Tomorrow	6
IV. The Opportunity—The Polaris System	7
V. Research and Development	7
VI. Our Submarine Construction Program	11
VII. Funding for Polaris Submarines	12
VIII. Nuclear Armaments and Undersea Warfare	13
IX. Weapons System Management	14
Appendix. Correspondence between Sen. Henry M. Jackson, chairman, Subcommittee on Military Applications, and the Secretaries of Defense and the Navy regarding the report of the panel	15

REPORT OF THE UNDERSEAS WARFARE ADVISORY PANEL TO THE MILITARY APPLICATIONS SUBCOMMITTEE OF THE JOINT COMMITTEE ON ATOMIC ENERGY

Introduction

On March 7 of this year, the Honorable Henry M. Jackson, chairman of the Military Applications Subcommittee of the Joint Committee on Atomic Energy, appointed an Advisory Panel on Undersea Warfare, consisting of the following members:

Dr. Harvey Brooks, dean of engineering and applied physics, Harvard University, and member, Committee on Undersea Warfare of the National Research Council.

Dr. Ivan A. Getting, vice president, engineering and research, Raytheon Manufacturing Corp., and member, Committee on Undersea Warfare of the National Research Council.

Dr. Gaylord P. Harnwell, president, University of Pennsylvania and member, Committee on Undersea Warfare of the National Research Council.

Mr. Kenneth Mansfield, former chief of special projects, Joint Committee on Atomic Energy, and assistant to the general manager, nuclear division, Combustion Engineering, Inc.

Dr. Oskar Morgenstern, professor of economics, Princeton University.

Dr. Roger Revelle, director, Scripps Institution of Oceanography.

This panel was requested by Senator Jackson to make findings and recommendations to the subcommittee concerning the adequacy of existing and planned programs for defending ourselves against enemy nuclear submarine forces, and for exploiting the offensive potential of underseas weapons systems with nuclear propulsion and nuclear armaments.

On March 17 and 18 the panel members were privileged to participate in 2 days of hearings held by the Military Applications Subcommittee on this subject.

The following witnesses from the United States Navy appeared during these hearings, or were interviewed by members of the panel:

Rear Adm. Rawson Bennett, Chief of Naval Research.

Rear Adm. J. T. Hayward, Deputy Assistant Chief of Naval Operations (Research and Development).

Rear Adm. R. L. Johnson, director, Long Range Objectives Group, Office of the Chief of Naval Operations.

Rear Adm. W. F. Raborn, director of special projects, Bureau of Ordnance.

Rear Adm. H. G. Rickover, Assistant Chief for Nuclear Propulsion, Bureau of Ships.

Rear Adm. C. E. Weakley, Office of Anti-Submarine Warfare Readiness, Office of the Chief of Naval Operations.

Although all the panel members have worked in areas relevant to this inquiry, they greatly profited from the authoritative testimony developed during the hearings.

The panel members wish to extend their thanks to the staff of the Joint Committee on Atomic Energy for its invaluable assistance.

We submit herewith our findings and recommendations.

I. Summary of Main Findings and Recommendations

FINDINGS

1. The time is rapidly nearing when the Soviet Union can possess, first a few, and then a large fleet of intermediate range ballistic missile-launching nuclear-propelled submarines.

2. The Soviets could mount a devastating nuclear warhead attack from the sea against the United States early in the 1960's.

3. Our existing defensive system could not stop such a missile attack.

4. No weapons system now in existence, even on an experimental basis, offers an adequate defense against nonsnorkeling submarines which run quiet and deep.

5. It is very doubtful whether the present scale and scope of research and development in undersea warfare will give us an effective defense against nuclear submarines in time to meet the threat.

6. Although defense against Polaris-type submarines may soon equal the problem of air defense in urgency, the funding of research and development in support of operational requirements for ASW has been grossly inadequate when compared with the support given such programs as air defense or missile development.

7. Too little research and development effort in the Navy is now directed toward major or order of magnitude improvements in weapons systems.

8. Basic scientific research in fields of great concern to undersea warfare but not immediately related to operational requirements has also been inadequately funded.

9. Basic research in oceanography is in particular now inadequately supported.

10. There is also urgent need for a major step-up in our program of oceanographic surveys.

11. The resources of universities, private research centers, and industry have not been adequately employed or developed for studying and solving undersea warfare problems.

12. The element of concealment gives the nuclear submarine a tremendous advantage over surface ships. Nuclear submarines will grow rapidly in importance in naval warfare—defensively in ASW and escort operations, and offensively in the destruction of commerce and Polaris-type systems.

13. Assuming no modification of our present and planned submarine-construction program, we believe that the Soviets will have it within their capability if they so desire to build a larger nuclear submarine fleet than our own by the mid-1960's.

14. The Polaris system possesses unique advantages as a deterrent force, and it is a matter of national importance that a force of Polaris submarines be brought into being at the earliest possible date.

15. The Polaris system will be a part of our national military deterrent against all-out war, and should be funded accordingly. It

29792—58——2

should be considered as outside the Navy's personnel and budget ceilings.

16. We have moved too slowly in developing nuclear weapons specifically optimized for ASW work, and in securing precise quantitative data concerning the effects of underwater nuclear explosions.

17. The bureau system of the Navy has serious shortcomings in the present era of highly integrated and complex weapons systems.

RECOMMENDATIONS

1. The Navy's research and development budget for systems immediately relevant to undersea warfare should be at least doubled in fiscal year 1959, and substantially and continually increased thereafter.

2. There should be a substantial and continuing increase in the Navy's budget for basic research not immediately related to operational requirements. The funding of both basic and applied research should be determined by the availability of qualified scientists and institutions, and should be designed to stimulate the continued orderly growth of universities, private research centers, and industries which can contribute to the solution of our long-range problems in undersea warfare.

3. Basic research in oceanography should in particular receive increased support.

4. The appropriate committees of the Congress should give serious consideration to increasing substantially the moneys available for oceanographic survey work, both on the high seas and in distant coastal areas.

5. The Navy should, as soon as possible, move to employ far more fully than in the past the resources of universities, private research centers, and industry for carrying out both basic and applied research on undersea warfare problems.

6. The rate and scale of out attack submarine construction program should be significantly increased.

7. The Navy should immediately proceed with the construction of an initial task unit of nine Polaris submarines, and authorization and appropriations for this purpose should be requested of the present session of the Congress.

8. The Polaris system, for funding purposes, should be entirely removed from the Navy's shipbuilding budget.

9. Construction budget requests for the Polaris system should be determined by the Secretary of Defense and the National Security Council, as part of our overall strategic deterrent budget.

10. The Navy and the Atomic Energy Commission should increase their efforts to develop new nuclear weapons specifically optimized for underseas warfare.

11. The Atomic Energy Commission and the Department of Defense should perform such additional underwater test shots as are needed to augment weapons effects data, to increase weapons efficiency, to improve ship design, and to minimize the size and yield of weapons required for ASW work. Such tests should of course be performed in a manner consistent with keeping radioactive contamination and fallout to a minimum.

12. A limited number of vertical management organizations, under officers reporting directly to the Chief of Naval Operations, should be established for such projects as ocean surveillance systems and attack submarine systems.

II. The Problem

The oceans of the earth are neutral.

They take no sides in struggles between men, faiths, and nations.

Yet for 150 years after the founding of our Republic, America regarded the ocean as its ally. In time of peace, the Atlantic and the Pacific insulated us from the quarrels of Europe and Asia. In time of war, these same oceans shielded our country against direct enemy attack. They were a vast highway for our Armed Forces. Over them, men and material were transported to battlefields far removed from our own cities and factories and farms.

But in the First and Second World Wars, the ocean appeared in different guise. We saw it now as our enemy, as well as our friend. Twice, the submarines of Germany, sheltered in the depths of the Atlantic, almost defeated the Allied coalition.

In a future war, the ocean could be our enemy as never before.

Two new elements have been introduced into naval warfare—the nuclear-propelled submarine, and the submarine-launched intermediate-range ballistic missile.

An attack by a single Polaris-type submarine, which might carry 16 or more missiles with hydrogen warheads, could decimate several of our cities. A massive attack with such weapons could level our entire urban society.

The day is rapidly nearing when the Soviet Union can possess, first a few, and then a large fleet of intermediate-range ballistic missile-launching nuclear-propelled submarines.

Our existing and presently planned defensive system could not stop such a missile attack. Therein lies the peril.

But side by side with this, the ocean can still be our friend, as never before. A fleet of missile-launching nuclear submarines in our own hands could inflict devasting reprisal against an aggressor in the event of all-out war. It could become a mainstay of our national deterrent force. Therein lies the opportunity.

In this mid-20tb century, we therefore face three problems in undersea warfare. One problem is old; two are new.

First, how best to carry out the traditional mission of our Navy? The free-world alliance system is essentially a maritime confederation. Its survival depends on the free transport of materials and people across the oceans and on the control of areas near sea coasts. Today, as in the past, our Navy must still do its traditional job of keeping the oceans open for friendly ships, and bringing superior concentrations of power to bear on coastal areas in other regions of the world.

Second, how best to protect the cities, factories, and military installations of our homeland against a new threat—missile-launching submarines? In a few years, the threat of strategic attack from the sea may equal in danger the threat of attack from land-based manned bombers and intercontinental missiles.

Third, how best to exploit the new power of submarine-launched missiles to increase our deterrent strength? How best to develop,

build, supply, maintain, and operate a fleet of nuclear missile-launching submarines.

III. The Peril—Today and Tomorrow

The antisubmarine warfare problem at present centers around detecting, identifying, localizing, and, if necessary, destroying on very short notice the units of an extremely large Soviet conventional submarine force consisting of about 475 vessels.

At the height of World War II, we confronted 440 German U-boats not equipped with schnorkels, with limited underwater endurance, and with an underwater speed not exceeding 12 knots. Operating against this force we had a total of 950 ocean going escorts and 2,200 ASW aircraft.

This compares with about 300 escorts and about 700 ASW aircraft operating today against Soviet submarines of much greater capability.

Because of the increased capability of the modern submarine, we could not produce or man the number of planes and ships which would be required to defeat these submarines by the tactics and methods of World War II. We must thus depend heavily on such concepts as ocean surveillance, the barrier or picket concept, and the coordinated hunter-killer team with long-range sonar and high mobility aircraft which can carry the battle to the enemy.

The protection of shipping is of prime importance in a limited war. In such a situation, we may be prevented by policy from attacking the enemy's home submarine bases or his production centers. It follows that the destruction of such bases should not be considered as part of our ASW strategy except in the event of all-out war.

If all-out war broke out within the next 2 years, the Soviet diesel-electric submarine fleet could inflict very severe damage against allied naval forces and shipping.

(Classified deletions.)

We must presume that the Soviets will soon possess nuclear submarines which can fire ballistic missiles. The threat from the sea against our cities may assume completely new, and more ominous, dimensions beginning about 1962.

(Classified deletions.)

Their capability in this area should increase rapidly thereafter.

(Classified deletions.)

Our present main line of surveillance and defense is relatively close to our own coasts. To counter the threat of missile-launching submarines we must develop and maintain secure barriers against them at distances from our coasts greater than the range of their missiles. Only thus can we reestablish the oceans as a protective moat around our shores.

To summarize: Nuclear-propelled missile-firing submarines will be vastly more difficult to destroy than conventional craft—and far more deadly. Furthermore, kill rates which would be tolerable for meeting the threat to shipping would be unacceptably low for countering the underwater missile threat.

Unless adequate countermeasures not now in existence become available, the Soviets could mount a devastating nuclear warhead attack from the sea against the cities of the United States early in the 1960's.

IV. The Opportunity—The Polaris System

Our Navy is now developing at top priority the Polaris weapon system. This system combines the destructive power of nuclear warheads and the hypersonic speed of ballistic delivery vehicles with the endurance and stealth of nuclear-propelled submerged launching platforms.

The superior nature of the Polaris system should be obvious.

First, it is relatively immune to surprise attack. Units of a Polaris fleet could move and be stationed submerged anywhere over millions of square miles of ocean and still be within striking distance of enemy targets.

Second, it enormously complicates the defensive problems of an enemy. It could launch a counterattack against the Soviet Union from anywhere over an arc of 270 degrees. Vast expenditures of money would be needed to entertain serious hope of neutralizing a Polaris fleet before it could accomplish its mission. Moreover, the relative lack of access of the Soviet Union to the oceans makes their problem of defense against this system more difficult than ours.

Third, it would be based on the empty ocean. It would operate hundreds or thousands of miles removed from the cities, the industries, and the land military installations of our own country and our allies. An enemy attack against a land-based deterrent would draw bombs toward our civilian populations, exposing them to the lethal effects of nuclear weapons, including radioactive fallout. But an attack against units of the Polaris system would not necessarily draw bombs to our heart land.

Fourth, it could help strengthen the free world alliance system. It would give our allies an alternative to a land-base deterrent force located in densely populated nations. It would make them better able to resist threats of "ballistic blackmail."

While not entirely invulnerable, a fleet of Polaris submarines is much less vulnerable than any other foreseeable deterrent system, and could be countered only by a tremendous diversion of research and industrial effort on the part of the enemy.

It thus adds immensely to our deterrent strength, and it is a matter of national importance that such a fleet be brought into being at the earliest possible date.

V. Research and Development

Research and development related to the detection, identification, localization and destruction of submarines has been supported on a much more modest scale than other national defense activities, such as air defense. This is so despite the fact that the defense against the Polaris type submarine may soon be of equal urgency with air defense.

It requires about 10 years to get a new weapons system into fleet use. Even if this lead time were reduced to 5 years, our situation with respect to undersea warfare would still be serious. There is now no weapons system in existence, even on an experimental basis, capable of coping with a non-snorkeling submarine which runs quiet and deep.

Underwater research generally is costly, slow, and unglamorous. Consequently it has failed to attract either the financial support or

the people drawn to fields easier to dramatize. Few universities, for example, carry on research or instruction in oceanography, while research in underwater acoustics is almost the exclusive province of Government laboratories. A bold program of construction of new facilities both for oceanography and acoustics could bring many new scientists into the field.

Much of the research and development money now available is devoted to small stepwise improvements in existing weapons systems and techniques. Although a certain proportion of the research budget is set aside for longer range "free-wheeling" type research, not enough money is available in any one place at any one time to support really bold and radical proposals requiring extensive new facilities.

It should be obvious that multiple approaches in research are necessary, and that at this stage more than one approach to the same operational requirement should be explored. Such apparent duplication is not wasted. On the contrary, true waste comes from manufacturing ineffective weapons, and from rushing prematurely into the production of inadequately engineered and untested equipment.

While there is reason to feel that research and development money is not now being spent as efficiently as possible, there is overwhelming evidence that the funds available are not adequate to meet the minimum needs of the Navy.

We cite five examples of critically important programs which should be prosucuted more vigorously.

1. DEVELOPMENT OF SYSTEMS TO UTILIZE UNDERWATER SOUND PHENOMENA

For the detection of submerged submarines, underwater sound seems to be the primary tool. The oceans are more transparent to sound than to any other form of energy; in fact, sound travels underwater over great distances. Under certain conditions present listening equipment is capable of obtaining a moderately accurate bearing on a fast moving or snorkeling submarine at about 100 miles. But this information by itself may prove to be of little value as a basis for action. This is not only because of the probable ease of jamming the listening devices, and because of their ineffectiveness against slower moving or deeper running submarines, but also because of the difficulties of localizing and tracking detected objects, and monitoring and coordinating attack units.

Active sonar techniques operating at low frequencies offer considerable theoretical promise, but except for very scattered and incomplete research information, the possible systems using active low frequency echo ranging exist almost entirely on paper, and we cannot even be certain that they offer an answer.

Intensive research in underwater sound is needed both to determine how much further improvement is possible in passive listening, and to determine the potentialities and requirements for active systems. Such research will require large hydrophone installations with associated shore-based equipment, and will also require research ships with expensive acoustic installations and submarine targets available on a continuous basis. The funds presently available for this type of work alone could easily be more than doubled, including investment for new experimental installations, without duplication or waste.

2. COMMUNICATIONS

Perhaps the single most important obstacle to the widespread use of submarines for ASW work and as missile launchers is the difficulty of communicating across the airwater interface, as well as underwater. This applies to communications between a submerged submarine, on the one hand, and shore installations, aircraft, surface ships, and other submarines on the other. There is now no sure, reliable, and efficient way of effecting such communication.

3. OCEANOGRAPHIC SURVEYS

The operational use of nuclear powered deep-running "true submarines" (for example, in the Polaris system) and the development of counter measures against these, including detection, identification, tracking, and attack, will inevitably require a far greater knowledge of the ocean waters and the underlying sea floor than we now possess. At present, even roughly accurate maps of the deep sea floor exist for only about 2 percent of the total ocean area. The modern Navy must also be prepared to operate off the coasts of any part of the earth. This requires a working knowledge of environmental, meteorologic, oceanographic, and topographic conditions in offshore areas throughout the world which is at least as good as that of our potential enemies. Such knowledge is now almost lacking in many regions.

The IGY program has temporarily stimulated oceanographic activities. However, unless more support is given these activities independently of IGY programs, we will sink back to the pre-IGY level in 1959.

The Soviet ocean surveying effort at the present time exceeds ours by at least threefold. Greatly increased United States effort is needed, utilizing known survey methods.

A committee of the National Academy of Sciences has estimated that accomplishment of the most essential surveys within a 10-year period would involve 15 to 30 deep sea vessels at a total cost of 20 to 30 million dollars a year. With adequate funds, much of this work could be conducted by the surveying agencies of the Federal Government, such as the Naval Hydrographic Office and the Coast and Geodetic Survey.

Oceanographic surveys should, of course, be distinguished from oceanographic research—the study of the fundamental properties of the ocean's waters and its bottom. An accelerated oceanographic research program is no less needed than a stepped-up survey program.

4. COMPACT NUCLEAR REACTORS

The naval reactors program has been an outstanding success. We will soon have in being an entire family of nuclear propulsion units, ranging in size and shaft horsepower from plants for hunter-killer submarines to plants for a large aircraft carrier. Our program aims at introducing highly reliable and combat-worthy reactors into the ships of our fleet at the earliest possible date.

With existing technology, the employment of nuclear power plants is limited to submarines of more than 2,000 gross tons, and to surface ships larger than conventional destroyers. The need for dispersed units in the age of nuclear weapons, to say nothing of matching Soviet

numerical superiority, argues for the desirability of relatively small naval ships. But, if such ships are to be nuclear propelled, they will need much smaller and lighter powerplants than can be constructed today. To build such plants, in turn, we must learn far more than we now know about reactor technology in general, and reactor materials in particular.

The technical difficulties involved in building compact powerplants are formidable. They apply not only to the reactor portion of the plants, but also to the associated propulsion equipment. Radical improvements in nuclear propulsion are not now in sight.

To the extent that technically worthwhile programs in this area can be devised, however, we should accelerate and broaden the scope of research and development projects specifically aimed at reducing the size and weight of nuclear-propulsion powerplants for naval application.

5. EXPERIMENTAL SHIPS

Progress in airplane design has involved a continuing program of constructing experimental aircraft. The Navy, however, has rarely built experimental ships. A program of design and construction of such ships, in order to study their performance characteristics and operational potentialities, should yield very large returns. Such a program might include different true submarines (rather than submersibles) capable of much higher speeds than present submarines—for example, heavier-than-water submarines using controllable planes to maintain depth. Likewise, design and construction of submarines capable of operating at depths of several miles might open up many new tactical possibilities.

In addition to a stepped-up applied research and development effort, it is essential that the Navy increase its support of basic research. There must be more emphasis on scientific fields of concern to the Navy, such as materials, oceanography, and meteorology.

We cite one example of needed basic research: There are many properties of the ocean's water and the ocean's bottom for which present survey methods are inadequate. These include measurement of deep sea currents, acoustic properties of the water, and acoustic and magnetic properties of the bottom. Far more basic oceanographic research at universities, industrial and Government laboratories will be needed to develop new surveying methods, and to use survey results most effectively.

Responsibility for the Navy's basic research program has been magnificently handled by the Office of Naval Research. But the "level budgeting" of ONR support during the last eight inflationary years has tended to reduce the number of basic research scientists because of the lack of job opportunities. At the same time, heavy emphasis on development by all the military services has tended to draw college graduates at the bachelor's level away from graduate research training in university laboratories.

We estimate that under the right conditions, the number of creative research scientists working in basic fields of relevance to the Navy could be increased by at least 10 percent per year, provided there were a corresponding increase in financial support for basic research. A considerably larger immediate increase is necessary to overcome the decline of the past few years.

The real limiting factor in basic research should be the availability of qualified personnel and institutions, not lack of funds.

We recommend that the Navy's research and development budget for systems immediately relevant to undersea warfare be at least doubled in fiscal year 1959, and substantially and continually increased thereafter.

We recommend that there be a substantial and continuing increase in the Navy's budget for basic research not immediately related to operational requirements. The funding of both basic and applied research should be determined by the availability of qualified scientists and institutions, and should be designed to stimulate the continued orderly growth of universities, private research centers and industries which can contribute to the solution of our long-range problems in underseas warfare.

We recommend that basic oceanographic research in particular receive increased support.

We recommend that the appropriate committees of the Congress give serious consideration to increasing the moneys available for oceanographic survey work, both on the high seas and in distant coastal areas.

We recommend that the Navy, as soon as possible, move to employ far more fully than in the past the resources of universities, private research centers, and industry for carrying out both basic and applied research on undersea warfare problems.

VI. Our Submarine Construction Program

Of the 110 submarines now in our active fleet, 3 are nuclear powered and the rest are diesel powered. Less than 15 vessels have been built since World War II.

In contrast, the Soviets have built over 300 submarines since the end of the Second World War, and their force now consists of about 475 submarines.

The element of concealment gives submarines a tremendous advantage over surface ships. As a matter of policy, we should move toward employing submarines for as many naval missions as they can perform.

It is almost certain that the nuclear submarine will become more and more important in naval warfare—defensively, in ASW and escort operations, and offensively, in attacks on shipping and Polaris-type systems. In addition, the submarine may come to be of great value for close support work in brush fire wars, in remote areas where an enemy might possess local air superiority.

We regard it as likely that the Soviets can soon have the capability of building many more nuclear submarines than we now plan to construct. The record of Soviet performance, both in building conventional submarines and in other military-scientific-industrial endeavors, leaves little room for doubt on this score. In fact, assuming a continuation of our present and planned construction program, we regard it as probable that the Soviets will have it within their capability to build a larger nuclear submarine fleet than our own by the mid-1960's.

Our present building program calls for 13 nuclear-powered attack submarines to be in operation by the end of 1960. Four or five of these could be kept on station at any one time. In 1960, therefore,

we would have only 2 or 3 nuclear attack submarines on station in the Atlantic, and a corresponding number in the Pacific.

We understand that the Navy now plans to build about 50 additional attack submarines during the decade 1960–70. By an attack submarine, we mean a vessel designed specifically to hunt down and kill enemy submarines. Making allowance for the obsolescence of our conventional submarines, this means that in 1970 there would be in operation about 65 nuclear-powered attack submarines and about 10 diesel electric craft. Of this total force, only 12 to 15 submarines could be on station in the Atlantic, with a matching force in the Pacific.

Keeping the largest possible number of submarines on station is of course a problem of prime importance. We do not believe that our present system of force deployment takes maximum advantage of our submarine fleet in this respect, and we urge that the Navy intensify its studies of ways and means of keeping a larger proportion of our submarine force on station.

Quite apart from this, however, we believe that our present and planned goals for the construction of attack submarines are too small.

Projected construction goals for Polaris submarines are not yet firm. We understand, however, that the Navy now thinks in terms of 40 such submarines being in operation by 1970.

The eventual size of our Polaris force is a question which will require constant reexamination, in the light of the comparative military worth of the Polaris versus alternative deterrent systems.

The problem of the ultimate composition of our Polaris force, however, is not the practical question confronting us today. The real problem at this time is building Polaris submarines in such number and with such speed that we secure as quickly as possible the beginnings of a sea-based deterrent of significant dimensions.

It is our understanding that the Navy's immediate plans call for the construction of five Polaris submarines. It is also our understanding that the Polaris fleet of the future will consist of multiples of task units of nine submarines each.

It is our belief that it would be desirable to proceed immediately with the construction of one such complete task unit.

We recommend that the rate and scale of our attack submarine construction program be significantly increased.

We recommend that the Navy immediately proceed with the construction of an initial task unit of nine Polaris submarines, and that authorization and appropriations for this purpose be requested of the present session of the Congress.

VII. Funding for Polaris Submarines

Funds for constructing Polaris-type submarines will come out of the Navy's regular shipbuilding budget. This appropriation covers the construction of carriers, cruisers, frigates, destroyers, tenders, mine sweepers, and all the other vessels employed by our Navy.

A Polaris-launching submarine is thus treated fiscally like any other naval vessel. In terms of its military mission, however, it is radically different from other ships in the fleet. Actually, the Polaris system is part of our national military deterrent against all-out war. It is an instrument of strategic reprisal. It is more analogous to a SAC bomber or a land-based IRBM or ICBM, than to other ships of our Navy.

Under existing funding regulations, Polaris submarines must compete for money with the rest of our shipbuilding program. This total construction budget is limited. Even if none of this money were spent on Polaris submarines, the funds would be stretched to the limit in meeting the Navy's minimum requirements for its traditional mission of controlling the seas.

From the standpoint of national deterrent strategy, the Polaris system should therefore not be treated as part of our regular shipbuilding program. In assigning money and priority to it, this system should be compared, not with other naval ships, but with the manned aircraft and land-based strategic missiles of our national deterrent force.

We recommend that, for funding purposes, the Polaris system be entirely removed from the Navy's shipbuilding budget.

We recommend that construction budget requests for the Polaris system be determined by the Secretary of Defense and the National Security Council, as part of our overall strategic deterrent budget.

VIII. Nuclear Armaments and Undersea Warfare

The lethal destructive radii of nuclear depth charges and torpedoes would appear to make atomic weapons highly effective armaments for an ASW force. On the face of it, they reduce the problem of localizing the enemy and permit less stringent guidance requirements on ASW weapons.

Nuclear armaments, however, place more exacting demands on target recognition, and there is some evidence suggesting that underwater nuclear explosions may affect the operation of the detection and identification devices now employed for ASW work.

In the 13 years since Hiroshima, our country has detonated many nuclear devices or weapons for test purposes, but there have been only a few underwater shots, which yielded limited amounts of information. Two more underwater tests are scheduled for the current Eniwetok series. They do not promise, however, to produce all the data needed properly to evaluate the role of nuclear weapons in ASW.

It is important that we secure more authoritative information through additional tests of the effects of underwater nuclear weapons. Such tests would also have a vital bearing on the design of new nuclear weapons and the tactical employment of submarines in all types of operations. They would, in addition, furnish data about possible hazards from radioactive contamination of food fishes.

We are not persuaded that we have in the past moved with sufficient vigor and imagination in developing nuclear weapons specifically optimized for undersea warfare. Nor are we certain that the weapons now being stockpiled or developed for ASW work take full advantage of the contributions which nuclear armaments can potentially make to destroying enemy forces.

We recommend that the Navy and the Atomic Energy Commission increase their efforts to develop new nuclear weapons specifically optimized for underseas warfare.

We recommend that the Atomic Energy Commission and the Department of Defense perform such additional underwater test shots as are needed to augment weapons effects data, to increase weapons efficiency, to improve ship design, and to minimize the size and yield

of weapons required for ASW work. Such tests should be of course performed in a manner consistent with keeping radioactive contamination and fallout to a minimum.

IX. Weapons Systems Management

The bureau system of the Navy was established at a time when naval technical problems were easily defined and separable. This system provides for independent control under chiefs with the rank of rear admiral. These billets represent the highest technical posts in the Navy.

To a large extent, the bureaus are staffed with personnel whose chief career goal is line responsibility within fleet commands and the Office of the Chiefs of Naval Operations, rather than promotion in technical grades.

It has been demonstrated repeatedly that the bureau system has shortcomings in the present area of highly integrated and complex weapons systems. These shortcomings assert themselves both in overall management and in technical decision making.

However, the admitted strength of the bureau system should be preserved until a better alternative is evolved. A precipitate departure from this system could cause unacceptable disruption.

In the meanwhile, a study should be made of manning within the technical bureaus, to make sure that technical decisions are made by properly trained selected civilians or technical officers. Promotions of technical career officers, moreover, should be consistent in scale and rank with those of line officers.

We regard it as more important to make a limited number of critical weapons systems available to the fleet on time than to cover all possible systems inefficiently and too late.

To this end, we believe that such vertical organizations of the type now used for management of the Polaris program would be useful for other high priority projects. This type of vertical management is most successful for engineering projects—systems programs which appear to be technically feasible within foreseeable advances in the state of the art. This type of management is not generally suitable for basic or long-range applied research. Also there is a distinct limit to the number of vertical organizations which can be operated at any one time, and the value of this system quickly declines once this number is exceeded.

We recommend that a limited number of vertical management organizations, under officers reporting directly to the Chief of Naval Operations and to the Secretary of the Navy, be established for such projects as ocean surveillance systems and attack submarine systems.

APPENDIX

CONGRESS OF THE UNITED STATES,
JOINT COMMITTEE ON ATOMIC ENERGY,
Washington, D. C., July 21, 1958.

The honorable the SECRETARY OF DEFENSE.

DEAR MR. SECRETARY: On March 7, 1958, I requested the following members of the Advisory Panel to the Subcommittee on Military Applications of the Joint Committee on Atomic Energy to make findings and recommendations to the subcommittee concerning the adequacy of existing and planned programs for defense against enemy submarine forces and for exploiting the offensive potential of nuclear underseas weapons systems:

Dr. Harvey Brooks, dean of engineering and applied physics, Harvard University, and member, Committee on Undersea Warfare of the National Research Council.

Dr. Ivan A. Getting, vice president, engineering and research, Raytheon Manufacturing Corp., and member, Committee on Undersea Warfare of the National Research Council.

Dr. Gaylord P. Harnwell, president, University of Pennsylvania, and member, Committee on Undersea Warfare of the National Research Council.

Mr. J. Kenneth Mansfield, former Chief of Special Projects, Joint Committee on Atomic Energy, and assistant to the general manager, nuclear division, Combustion Engineering, Inc.

Dr. Oskar Morgenstern, professor of economics, Princeton University.

Dr. Roger Revelle, director, Scripps Institution of Oceanography.

All of these panel members are experienced in areas relative to the subject matter and participated with the subcommittee in 2 days of hearings held by the Subcommittee on Military Applications on March 17 and 18, 1958.

I am enclosing for your assistance a report submitted to the subcommittee by the panel in which the panel made 12 major recommendations which the panel members believe are necessary if the United States is to effectively defend itself against enemy submarine forces and better exploit the offensive potential of nuclear underseas weapons systems. I strongly believe that the enclosed report will be of assistance to you in determining future Department of Defense policies and that if the recommendations are followed, they will do much to guarantee continued United States naval supremacy in the years to come.

I am also sending a copy of this report to the Secretary of the Navy.

Sincerely yours,

HENRY M. JACKSON,
Chairman, Subcommittee on Military Applications.

THE SECRETARY OF DEFENSE,
DEPARTMENT OF DEFENSE,
Washington, D. C., July 30, 1958.

Hon. HENRY M. JACKSON,
Chairman, Subcommittee on Military Applications, Joint Committee on Atomic Energy, Congress of the United States.

DEAR SENATOR JACKSON: We have received and noted with interest your letter of July 21, 1958, forwarding a report of your advisory panel dealing with offensive and defensive features of nuclear underseas weapons systems.

The experience and competence of the panel members is impressive. The report deserves, and will receive, most careful consideration.

Sincerely yours,

NEIL MCELROY

THE SECRETARY OF THE NAVY,
DEPARTMENT OF THE NAVY,
Washington, August 15, 1958.

Hon. HENRY M. JACKSON,
United States Senate,
Washington, D. C.

MY DEAR SENATOR JACKSON: Your letter of July 21, 1958, and the enclosed copy of the report of the advisory panel to the Subcommittee on Military Applications of the Joint Committee on Atomic Energy have been studied with interest. The report should be of great help to us in orienting and further enlarging our effort in undersea warfare.

As you may know, certain of the matters covered by the panel are already underway. For example, the ASW research and development effort originally planned for fiscal year 1959 was enlarged during the Department of Defense consideration of the Navy budget. It was again enlarged by the addition of $48 millions, by a requested amendment, after the budget went to the Congress. As another example, we are now in process of altering three vessels to oceanographic research ships as an immediate augmentation in this area and are embarked on an enlarged program of extended oceanographic effort. If even more proves to be needed, we are prepared to undertake it.

The report of the panel has been turned over to the Chief of Naval Operations for his analysis and use in connection with shaping the effort in undersea warfare. Further information as to the Navy's progress in antisubmarine warfare will be forwarded to you prior to the next session of the Congress.

All of us in the Navy are keenly aware of this critical threat which we face in the field of undersea warfare, both to our sea lines of communication and to the continental United States. The problems involved embrace nearly every scientific, technical and operational aspect of naval warfare. We have made considerable progress, but we are keenly aware that we must make a great deal more if the threat is to be overcome. In this task the understanding and support of you and your colleagues will continue to be an invaluable asset.

Thank you for making this report available to the Navy.

Sincerely,

THOMAS S. GATES.

○